We claim:

1. A method for monitoring fabrication processes of structured surfaces in a semiconductor production, the method which comprises:

providing reference signatures of structured surfaces by measuring at least one distribution selected from the group consisting of a local distribution and an intensity distribution of images selected from the group consisting of diffraction images and scattered light images of a plurality of individual structures of surfaces of production prototypes having a specified quality;

measuring at least one signature of a test specimen surface to be monitored by simultaneously registering a plurality of individual structures of the test specimen surface to be monitored for providing a measured signature;

comparing the measured signature with the reference signatures for providing comparison results; and

classifying parameters of the test specimen surface based on the comparison results.

2. The method according to claim 1, which comprises providing the plurality of individual structures such that the plurality of individual structures form a nonperiodic pattern.

3. The method according to claim 1, which comprises providing the plurality of individual structures such that the plurality of individual structures form a lattice having different periodicities along different directions.

4. The method according to claim 1, which comprises generating the reference signatures optically by measuring at least one of a diffraction and a scattering of an electromagnetic radiation at the structured surfaces.

5. The method according to claim 1, which comprises generating the at least one signature optically by measuring at least one of a diffraction and a scattering of an electromagnetic radiation at the plurality of individual structures of the test specimen surface to be monitored.

6. The method according to claim 1, which comprises performing the comparing step and the classifying step by using at least one of a fuzzy logic and a neural network having a learning capability.

7. The method according to claim 6, which comprises:

measuring individual structures of an already classified test specimen surface with a high-resolution measuring device for specifying a quality of the test specimen surface and for providing a further reference signature; and

comparing a result of the step of classifying the parameters of the test specimen surface to a result of the step of measuring the individual structures of the already classified test specimen surface with the high-resolution measuring device for providing a comparison result and adjusting a weighting of at least one of the fuzzy logic and the neural network as a function of the comparison result.

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8. The method according to claim 1, which comprises generating the reference signatures by measuring the intensity distribution of the images selected from the group consisting of the diffraction images and the scattered light images while varying at least one parameter selected from the group consisting of a polarization, an angle of incidence and a wavelength of an electromagnetic radiation.

9. The method according to claim 1, which comprises measuring the at least one signature by measuring an intensity distribution of an image selected from the group consisting of a diffraction image and a scattered light image while varying

at least one parameter selected from the group consisting of a polarization, an angle of incidence and a wavelength of an electromagnetic radiation.

10. The method according to claim 1, which comprises classifying the test specimen surface by selectively classifying the test specimen surface as a good test specimen surface and a bad test specimen surface.

11. The method according to claim 1, which comprises providing a classification in accordance with graduated quality classes for classifying the test specimen surface.

12. The method according to claim 1, which comprise providing a classification in accordance with specific production faults for classifying the test specimen surface.

13. The method according to claim 1, which comprises monitoring a production of periodic memory element structures.

14. The method according to claim 1, which comprises monitoring a production of nonperiodic logic structures.

15. The method according to claim 1, wherein the step of providing the reference signatures includes producing a classification system by assigning given production prototypes

having a specified quality to measurement data of the reference signatures of the given production prototypes.

16. The method according to claim 1, wherein the step of providing the reference signatures includes producing a classification system by assigning at least one of the production prototypes having the specified quality and measurement data of the reference signatures of the production prototypes to at least two classes.

17. The method according to claim 1, wherein the step of providing the reference signatures includes providing reference signatures for different products, and the step of classifying the parameters of the test specimen surface includes identifying a product.

18. The method according to claim 1, wherein the step of providing the reference signatures includes adjusting at least one of the production prototypes in different ways, and the step of classifying the parameters of the test specimen surface includes classifying a misadjustment of a test specimen.

19. The method according to claim 1, which comprises providing the structured surfaces as microstructured surfaces.

20. A device for monitoring fabrication processes of structured surfaces in a semiconductor production, comprising:

a reference signature apparatus for providing reference signatures of structured surfaces, said reference signature apparatus being configured for performing a measurement of reference signatures by measuring at least one distribution selected from the group consisting of a local distribution and an intensity distribution of images selected from the group consisting of diffraction images and scattered light images of a plurality of individual structures of a surface of production prototypes having a specified quality;

a measuring apparatus operatively connected to said reference signature apparatus, said measuring apparatus measuring at least one signature associated with a test specimen surface to be monitored by simultaneously registering a plurality of individual structures of the test specimen surface to be monitored for providing a measured signature;

a comparison module operatively connected to said measuring apparatus, said comparison module comparing the measured signature with the reference signatures and providing comparison results; and

a classification module operatively connected to said comparison module, said classification module classifying parameters of the test specimen surface through the use of the comparison results.

21. The device according to claim 20, wherein said reference signature apparatus, said measuring apparatus, said comparison module, and said classification module are integrated in a semiconductor fabrication line for providing at least one of an in situ production monitoring and an in-line production monitoring.

22. The device according to claim 20, wherein:

said measuring apparatus includes an electromagnetic radiation source for providing a coherent electromagnetic radiation, a rotation apparatus for rotating a polarization of the coherent electromagnetic radiation, said rotation apparatus rotating the polarization in one of an infinitely adjustable manner and in small increments, and at least one electromagnetic radiation detector; and

said measuring apparatus is configured such that the coherent electromagnetic radiation hits a structured test specimen surface at a fixed angle of incidence, and such that one of a local distribution and an intensity distribution of a

diffraction image generated by reflecting the coherent electromagnetic radiation at the structured test specimen surface is measured as a function of the polarization by using said at least one electromagnetic radiation detector.

23. The device according to claim 20, wherein said measuring apparatus includes an electromagnetic radiation source for providing an electromagnetic radiation with a given wavelength, the wavelength is selected such that dimensions of the individual structures of the test specimen surface are of a same order of magnitude as the given wavelength.

24. The device according to claim 20, wherein:

said measuring apparatus includes an electromagnetic radiation source for providing an electromagnetic radiation with one of a plurality of wavelengths and a plurality of wave length ranges; and

said measuring apparatus carries out a measurement one at a time as a function of the one of the plurality of wavelengths and the plurality of wave length ranges.

25. The device according to claim 20, wherein:

said measuring apparatus includes an electromagnetic radiation source for providing an electromagnetic radiation with one of a plurality of wavelengths and a plurality of wave length ranges; and

said measuring apparatus carries out a measurement simultaneously with the one of the plurality of wavelengths and the plurality of wave length ranges.

26. The device according to claim 20, wherein said measuring apparatus includes a spectral lamp for providing coherent light and filters for extracting various wavelength ranges from the coherent light.

27. The device according to claim 20, wherein:

said measuring apparatus includes an electromagnetic radiation source for providing an electromagnetic radiation and a rotation apparatus for rotating a polarization of the electromagnetic radiation;

said rotation apparatus rotates the polarization in one of an infinitely adjustable manner and in small increments, and said rotation apparatus is an element selected from the group consisting of a $\lambda/2$ plate, two $\lambda/4$ plates, an electro-optical

element, and a mechanical rotating apparatus for mechanically rotating said electromagnetic radiation source.

28. The device according to claim 20, including a movable mounting table for holding a test specimen when measuring at least one distribution selected from the group consisting of a local distribution and an intensity distribution of diffraction images in various regions of the test specimen.

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29. The device according to claim 20, wherein said measuring apparatus is moved with respect to a test specimen when measuring at least one distribution selected from the group consisting of a local distribution and an intensity distribution of diffraction images in various regions of the test specimen

30. The device according to claim 20, wherein said measuring apparatus examines an electromagnetic radiation reflected by the test specimen surface to be monitored.

31. The device according to claim 20, wherein said classification module includes a diffraction simulator for determining absolute profile parameters from measured signatures.